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SEA REMOTE SENSING PROGRAM

MISSISSIPPI SOUND REMOTE SENSING STUDY

AUGUST 15, AUGUST 29, SEPTEMBER 7

SURFACE MEASUREMENTS

REPORT NO. 033

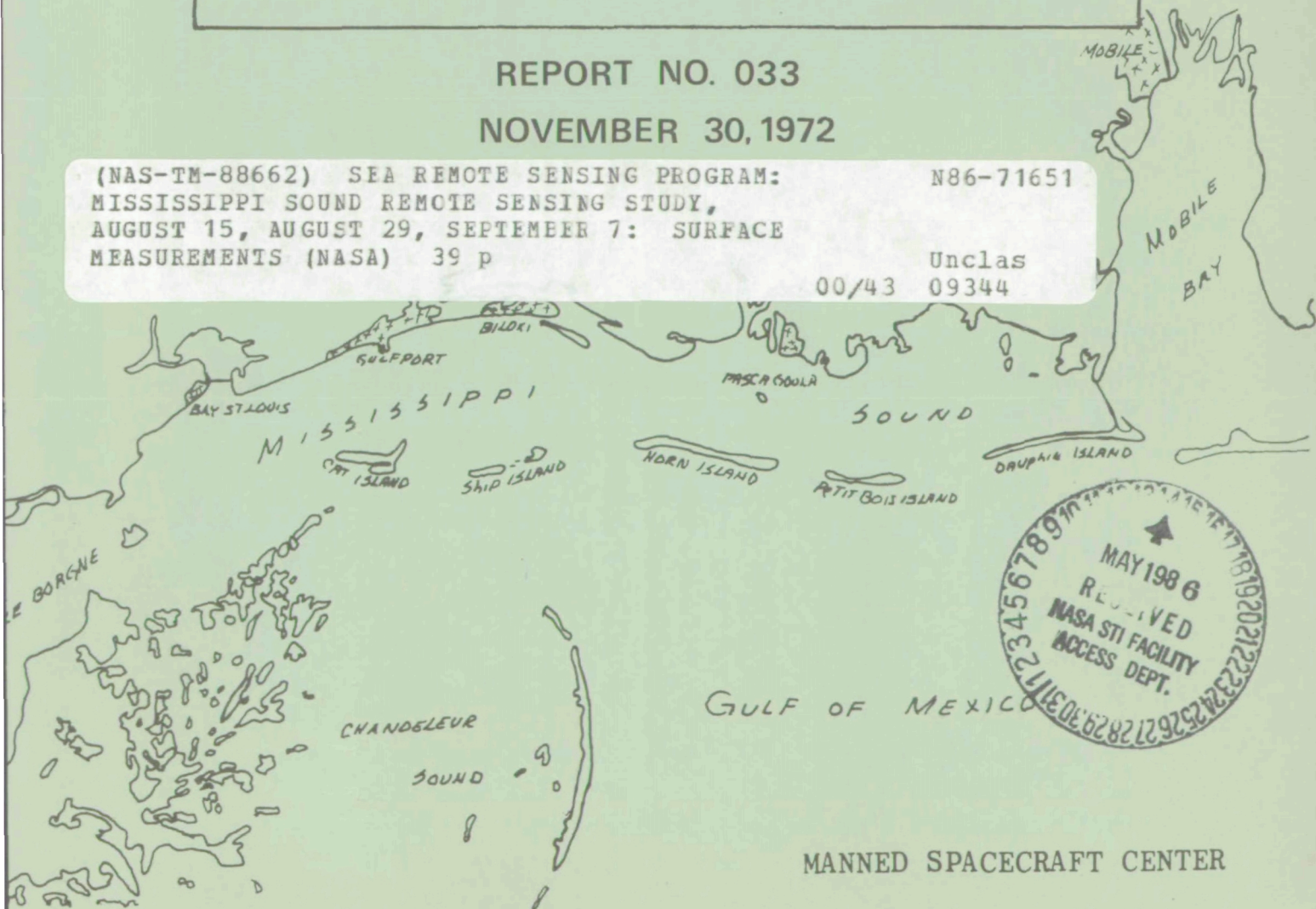
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INTRODUCTION

As a part of the remote sensing program of the NASA Earth Resources Laboratory (ERL), a study of the Mississippi Sound was initiated in early 1971. The first phase of this study consisted of four overflights by NASA aircraft with supporting surface measurements. Reports summarizing the surface data collected for each of the overflights - July 22, 1971, November 10, 1971, January 26, 1972, and May 2 and 4, 1972 - have been published by the NASA Earth Resources Laboratory.

The study has now entered a second phase in cooperation with the National Marine Fisheries Service (NMFS) ERTS-A experiment #240¹ in which additional scientific objectives have been included. One of the objectives is the assessment of the influences of physical parameters on the menhaden fishery within the Mississippi Sound and in nearby waters of the Gulf of Mexico and how effectively these parameters may be measured remotely. The other is the inclusion of data obtained from the ERTS-A satellite in the evaluation of remote measurements.

As a part of this second phase - in addition to the "main day" or "primary" experiments in which complete coverage of the Sound is attempted - a series of weekly experiments have been planned. The weekly surface measurements are confined to a particular section of Mississippi Sound which is selected on the basis of the menhaden fishery activity. Aircraft measurements are concentrated in the selected area, but also include other portions of the Mississippi Sound. A report summarizing the surface data collected for the first four weekly overflights - July 11, 1972, July 19, 1972, July 25, 1972 and August 1, 1972 - has been published by the NASA Earth Resources Laboratory.

This report contains surface data collected during three of these weekly experiments - August 15, 29 and September 7, 1972. Remote data will be reported separately.

¹Project Plan - ERTS-A Experiment dated July 21, 1972

The surface measurements were made and water samples collected from one vessel (leased by NASA Earth Resources Laboratory) which occupied all the stations within a given section in a serial manner. The technical personnel aboard the research vessel were members of Lockheed Electronic Company, support contractor to the ERL.

Salinity and chlorophyll concentrations were determined from the collected water samples, and data in these reports compiled by Lockheed Electronics personnel.

A complete list of publications reporting on previous experiments and other phases of this study may be found in Appendix 1.

MATERIALS AND METHODS

Field measurements and samples were taken at eight stations in the Mississippi Sound on July 15, 1972, nine stations on July 29, 1972, and eight stations on August 7, 1972 (Tables 7, 8 and 9). These data were taken as supporting surface measurements for ERL/NMFS/ERTS-A mission 34-6, 34-8, and 34-9.

Surface water temperature measurements were made with a bucket thermometer. Temperature and salinity measurements were made with a Beckman RS5-3 salinometer and are listed in the remarks column (Tables 7, 8 and 9).

Air temperature measurements were taken with mercury bulb thermometers as near the water surface as possible on the shady side of the boat.

Relative humidity values were determined with a sling psychrometer.

Wind direction, wind speed, and sea state observations were in most cases estimated.

Water transparency was determined with secchi disks.

Color was determined with a Forel-Ule color comparator.

The time of flyover (CDT) with the Twinbeech aircraft for each flight line was:

August 15, 1972

Line 7	0920-0948
Line E-6	1000-1004
Line E-5	1007-1012
Line E-4	1015-1018

August 29, 1972

Line 7	0919-0941
Line D-6	0951-0954
Line D-5	0959-1003
Line D-4	1007-1011

Sept. 7, 1972

Line 7	0903-0929
Line E-6	0941-0944
Line E-5	0948-0953
Line E-4	0959-1005

See flight line map in back pocket.

MATERIALS AND METHODS

Figures 1, 3 and 5 are National Weather Service surface weather maps and station weather. Figures 2, 4 and 6 are Skew T-Log P diagrams with dashed lines plotting dew point and solid lines plotting temperature. These are accompanied by Tables 1, 2 and 3 that represent machine processed radiosonde data.

Located in the pocket on the rear cover is a planned flight line and station map.

Data computations and listings were made with the Univac 1108 (Tables 7, 8, and 9). Below is a nomenclature list.

<u>Column</u>	<u>Abbreviation</u>	<u>Name</u>
1	STAT NUMB	station number
2	TIME CDT	time central daylight time
3	WATER TEMP DEG C	water temperature degrees centigrade
4	CHLO PH A MG/M3	chlorophyll <u>A</u> milligrams per cubic meter
5	SALNTY PTS/K	salinity parts per thousand
6	AIR TEMP DG C	air temperature degrees centigrade
7	RELAT HUMDY PERCT	relative humidity percent
8	WIND DIR DEG	wind direction degrees
9	WIND SPD KN	wind speed knots
10	SECH VISB FT	secchi visibility feet
11	SEA STAT FT	sea state feet
12	WATER DEPTH FT	water depth feet
13	BOTL NO.	bottle number
14	FU COL	forel-ule color
15	REMARKS	remarks

Laboratory Procedures

Water samples were taken at each station in pint polypropylene bottles for chlorophyll and salinity analyses.

Salinities were run with a Beckman Model RS-7B Induction Salinometer. Standard (35 ‰) sea water was used as reference, and salinities were determined from the conductivity ratio of the sample to that of the standard. Temperature and instrument drift corrections were made according to the Beckman Manual.

The technique used for determination of chlorophyll, which gives a measure of the phytoplankton present, was essentially that proposed by SCOR-UNESCO working group 17 in Determination of Photosynthetic Pigments in Sea-Water, UNESCO, Paris 1969. Each water sample for chlorophyll analysis was filtered through a millipore 0.45 micron acetate filter. The filters and their residue were stored at -15°C over activated silica gel. Each filter and its residue was ground in a teflon tissue grinder. Ninety percent acetone was used as the extracting agent. The acetone homogenates were stored in the dark for ten minutes, then centrifuged at 2000 g for approximately one hour instead of the recommended ten minutes because the extract was too turbid. The volume of each extract was recorded and the absorption spectrum of the chlorophyll extract measured against a blank acetate filter dissolved in 90% acetone. The measurements were made on a Cary 17 Spectrophotometer.

The absorption spectra were indexed at 750, 663, 645, and 630 mμ. The absorption at 663, 645 and 630 mμ was corrected by comparison with the absorption of the "reference blank" at 750 mμ. These corrected values are used in the following formula to determine chlorophyll A.

$$\text{chl } \underline{A} = (11.64 \times e_{663} - 2.16 \times e_{645} + 0.10 \times e_{630}) \times$$

$$\frac{\text{ext (ml)}}{\text{vol (l)}} \times \frac{1}{\text{absorption cell light path (cm)}}$$

MATERIALS AND METHODS

Laboratory Procedures (cont'd)

where e_{663} = absorption at 663 $m\mu$

e_{645} = absorption at 645 $m\mu$

e_{630} = absorption at 630 $m\mu$

ext = extract volume

vol = volume of sample

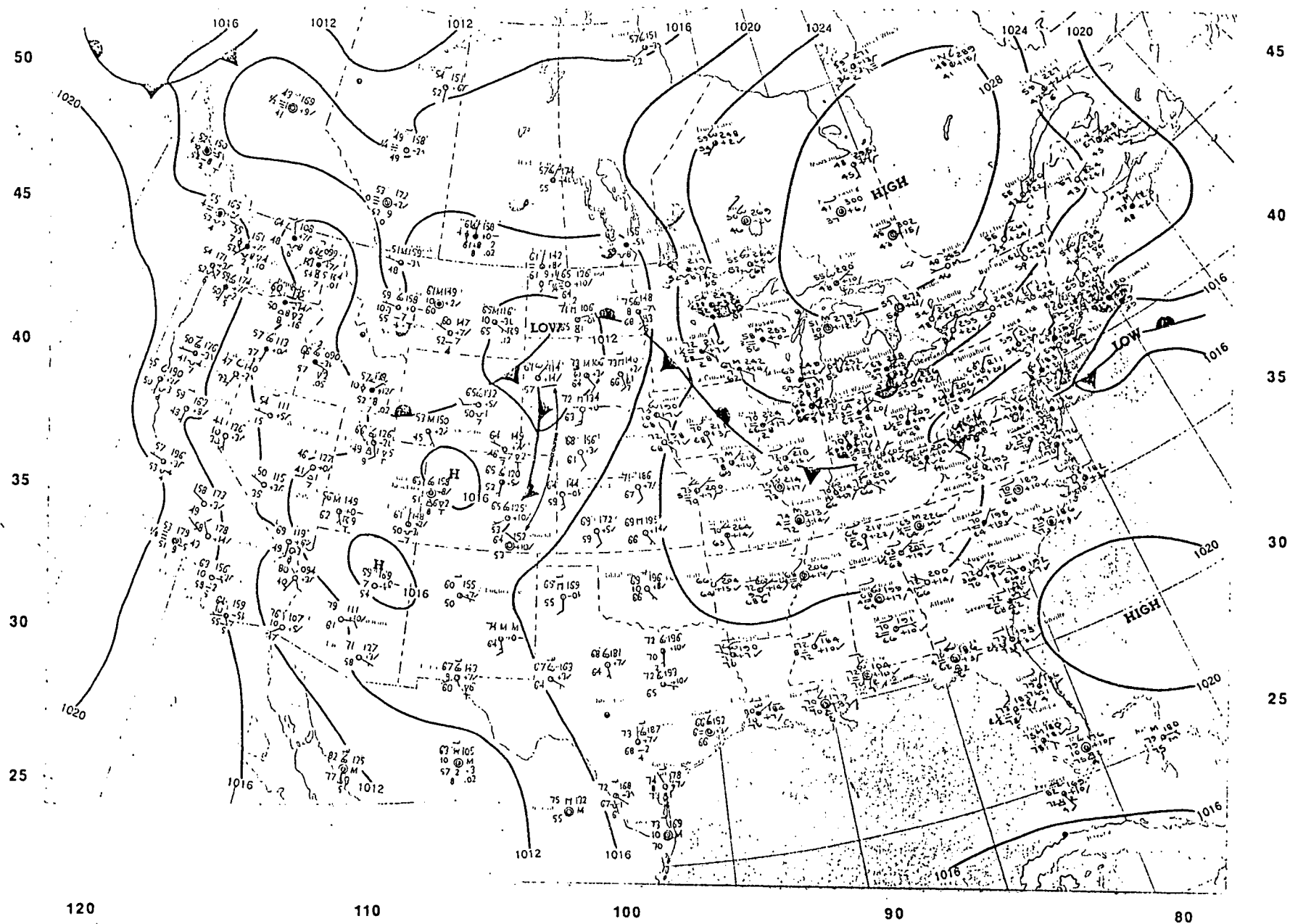


FIGURE 1.

NATIONAL WEATHER SERVICE
SURFACE WEATHER MAP AND
STATION WEATHER AT 0000 GMT
TUESDAY, AUGUST 15, 1972.

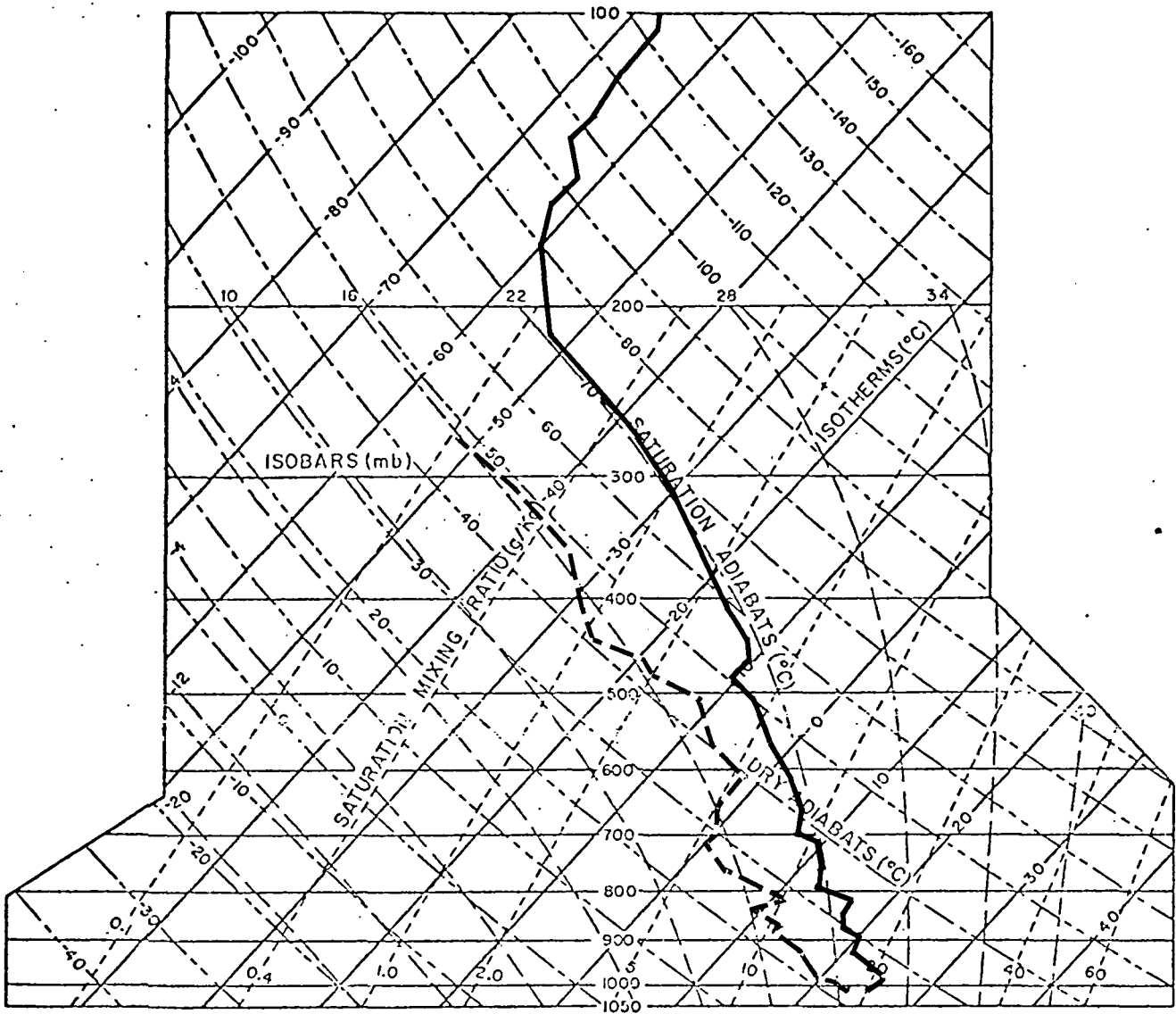


FIGURE 2.

Skew T - Log P diagram with dashed lines plotting dew point and solid lines plotting temperature 15 August 1972.

<u>PRESSURE</u>	<u>TEMP.</u>	<u>DEW POINT</u>	<u>HEIGHT</u>
<u>MILLIBARS</u>	<u>CENTIGRADE</u>		<u>METERS</u>
1018.0	24.0	22.8	0
994.0	24.4	21.2	209
987.2	24.1	20.2	269
983.0	23.9	19.5	307
959.0	22.7	18.3	522
931.7	21.2	16.8	775
925.0	20.8	16.4	838
904.0	20.0	14.3	1035
879.0	19.1	11.7	1279
877.3	18.9	12.2	1295
875.0	18.6	12.8	1318
850.9	16.9	10.2	1557
844.0	16.3	9.4	1627
825.2	15.2	10.0	1818
824.0	15.1	10.1	1831
799.3	13.3	8.6	2088
793.0	12.8	8.2	2156
774.6	11.9	5.8	2353
761.0	11.3	4.1	2501
750.1	10.7	3.1	2621
725.7	9.4	1.0	2896
719.0	9.0	.3	2974
701.5	7.6	.8	3177
700.0	7.4	.8	3196
677.2	6.4	-.4	3468

TABLE 1. Machine processed radiosonde data available from
Mississippi Test Facility 1400 GMT, 15 August 1972.

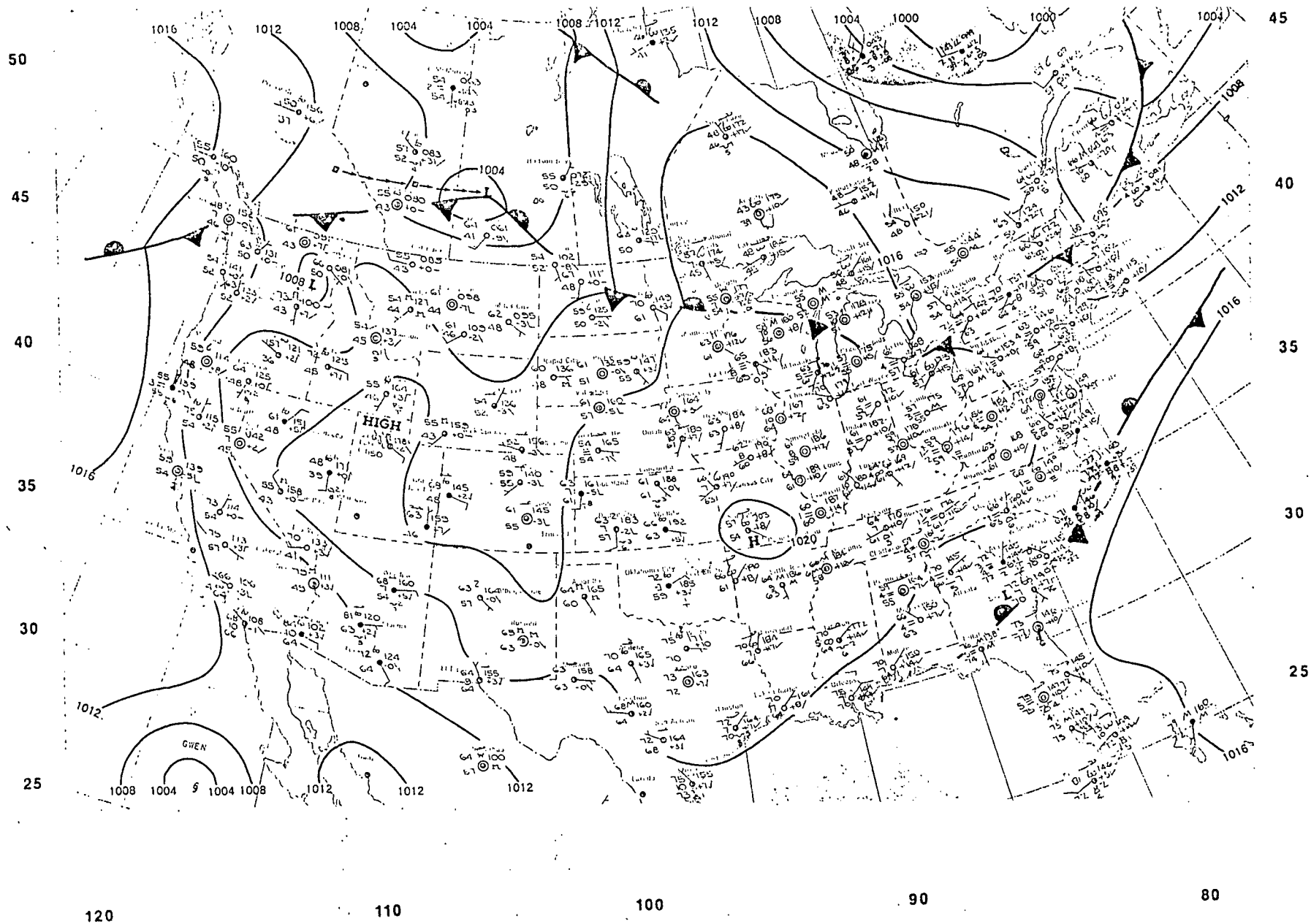


FIGURE 3.

NATIONAL WEATHER SERVICE
SURFACE WEATHER MAP AND
STATION WEATHER AT 0000 GMT
TUESDAY, AUGUST 29, 1972.

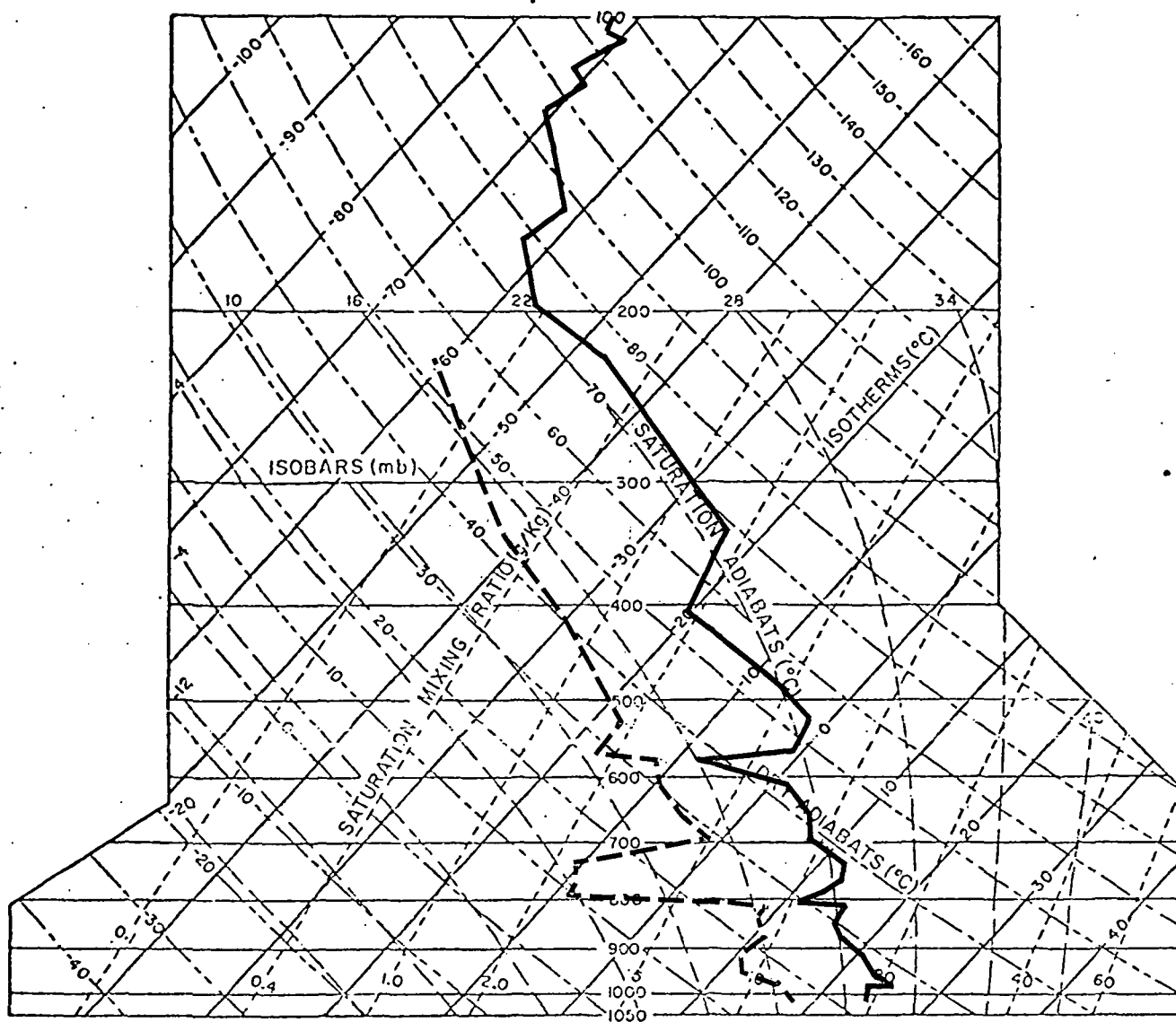


FIGURE 4. Skew T - Log P diagram with dashed lines plotting dew point and solid lines plotting temperature.
29 August 1972.

<u>PRESSURE</u>	<u>TEMP.</u>	<u>DEW POINT</u>	<u>HEIGHT</u>
<u>MILLIBARS</u>	<u>CENTIGRADE</u>		<u>METERS</u>
1014.0	24.6	18.6	0
994.0	23.0	16.8	174
984.0	24.3	15.6	262
982.0	24.6	15.3	281
960.0	23.2	12.1	479
953.5	22.9	11.8	537
924.4	21.2	10.6	806
915.0	20.6	10.2	896
896.3	19.3	10.3	1074
869.0	17.5	10.4	1340
854.0	15.8	9.8	1489
842.0	15.8	5.4	1609
815.7	12.8	8.5	1877
814.0	12.6	8.7	1895
804.0	11.4	5.0	1999
793.0	13.7	- 9.2	2114
788.7	13.7	- 9.2	2159
773.0	13.9	- 9.2	2329
763.5	13.5	- 9.5	2433
750.0	12.9	-10.0	2583
737.9	11.9	- 8.6	2718
712.7	9.7	- 5.5	3007
690.0	7.6	- 2.6	3277
688.4	7.6	- 2.8	3296
665.0	7.5	- 6.6	3581

TABLE 2. Machine processed radiosonde data available from
Mississippi Test Facility 1400 GMT, 29 August 1972.

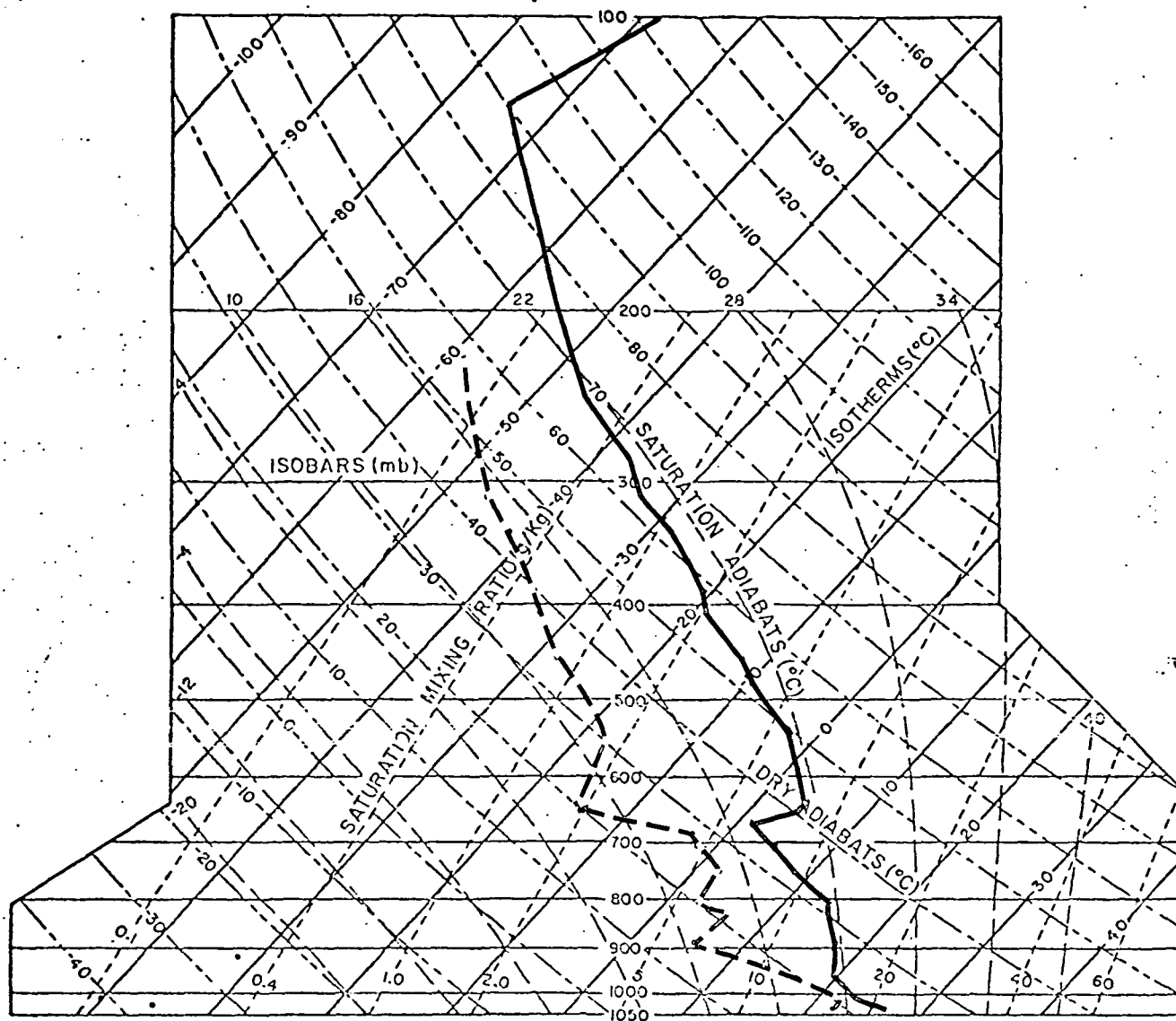


FIGURE 6. Skew T-Log P diagram with dashed lines plotting dew point and solid lines plotting temperature 7 September 1972.

<u>PRESSURE</u>	<u>TEMP.</u>	<u>DEW POINT</u>	<u>HEIGHT</u>
<u>MILLIBARS</u>	<u>CENTIGRADE</u>		<u>METERS</u>
1016.0	29.0	24.3	0
995.0	25.8	24.1	185
984.2	25.1	23.0	281
959.0	23.4	20.3	510
956.4	23.2	20.0	534
940.0	21.8	17.8	685
927.0	21.4	15.9	805
900.0	20.5	11.8	1062
873.7	19.6	7.7	1318
869.0	19.4	6.9	1365
847.1	18.2	7.1	1584
821.0	16.7	7.4	1851
813.0	16.2	7.4	1936
795.7	15.7	4.8	2118
792.0	15.6	4.2	2158
770.9	13.6	3.9	2385
746.9	11.2	3.5	2651
734.0	9.8	3.3	2798
723.3	9.0	2.4	2918
700.3	7.0	.2	3186
691.0	6.2	- .6	3297
678.2	4.7	-1.4	3450
671.0	3.8	-1.9	3537

TABLE 3. Machine processed radiosonde data available from
Mississippi Test Facility 1429 GMT, 7 September 1972.

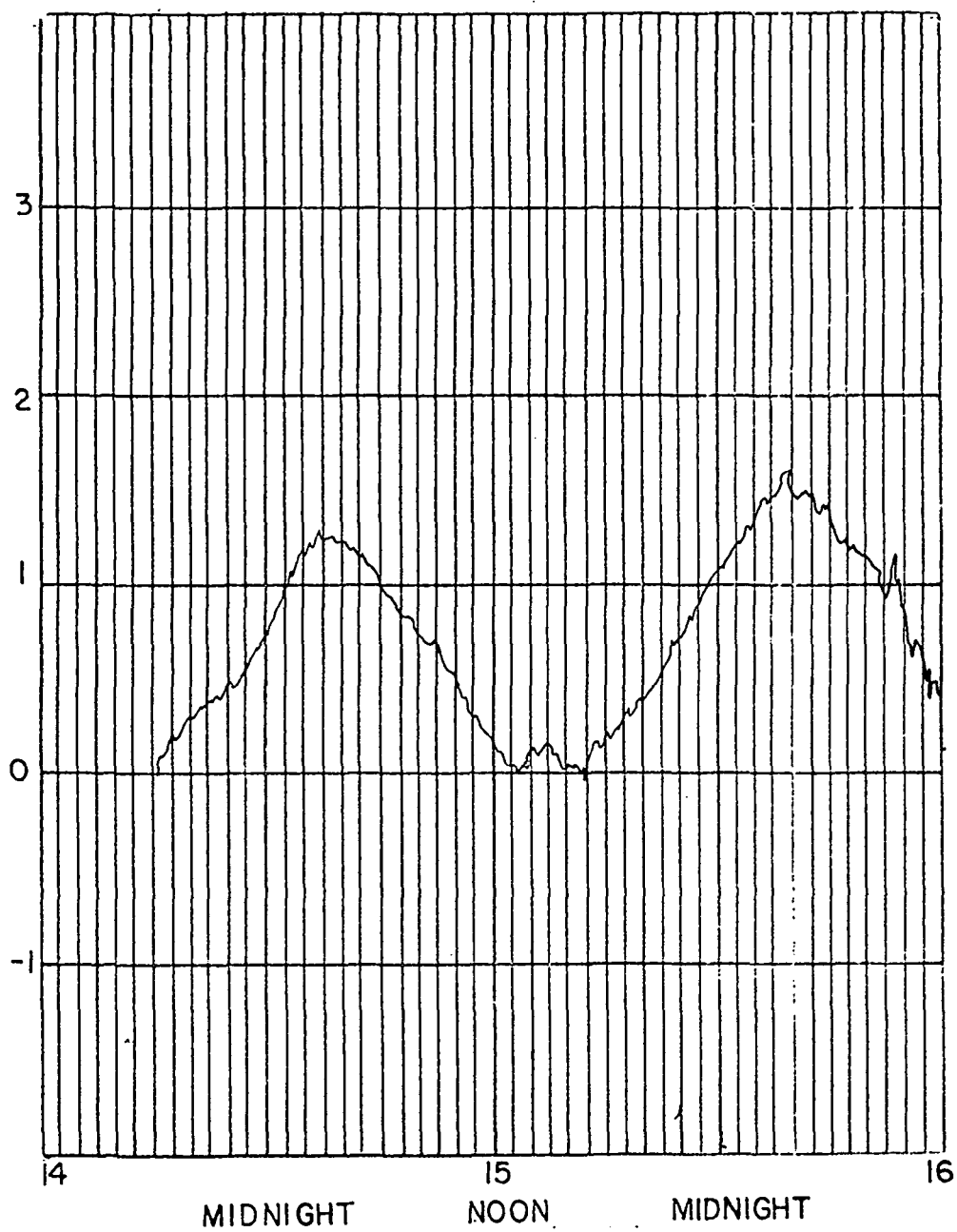


Figure 7. Tides at Gulfport, Miss.

Gage Zero 0.00 MSL

August 15, 1972.

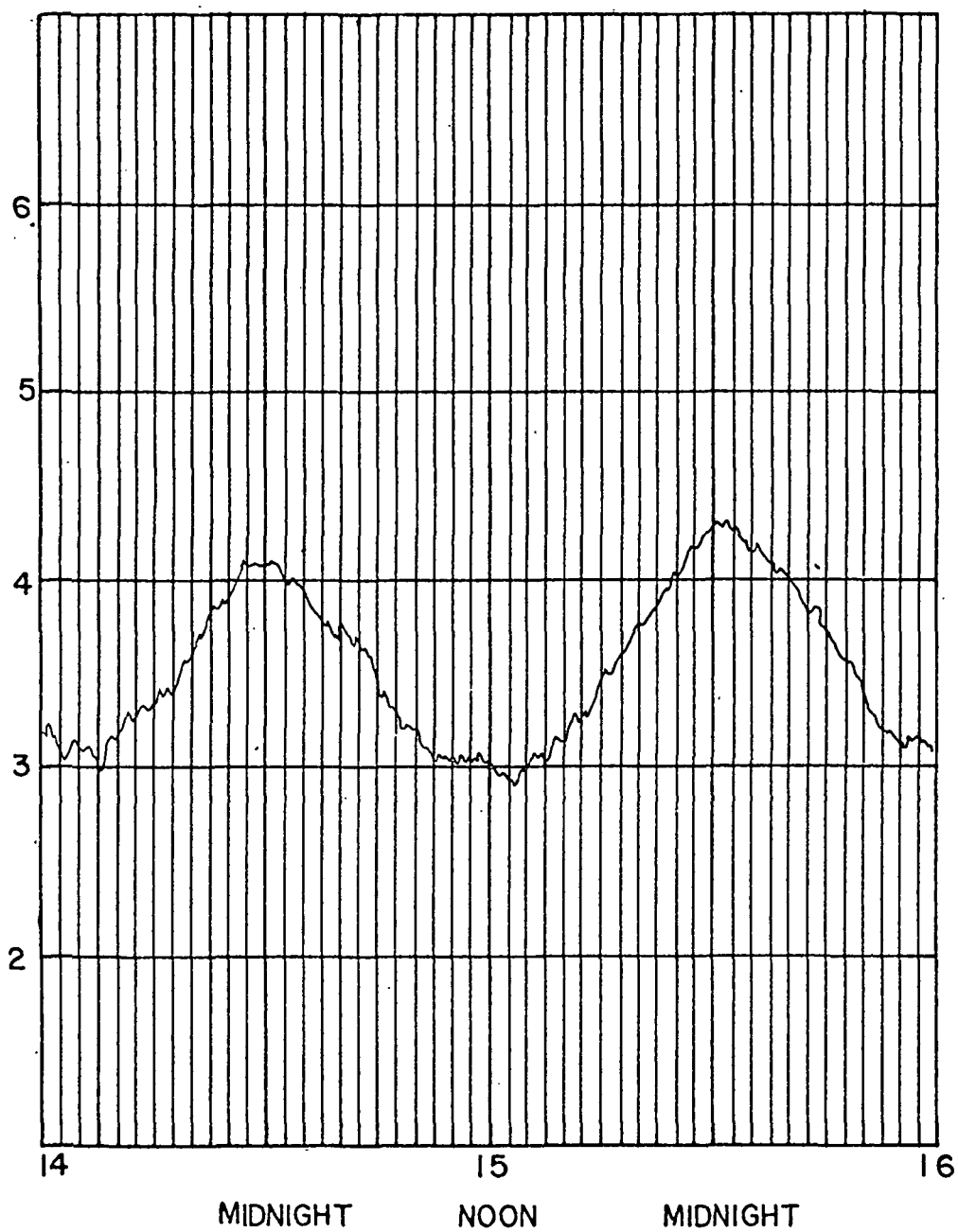


Figure 8. Tides at Pascagoula, Miss.

Gage Zero 3.11 MSL

August 15, 1972.

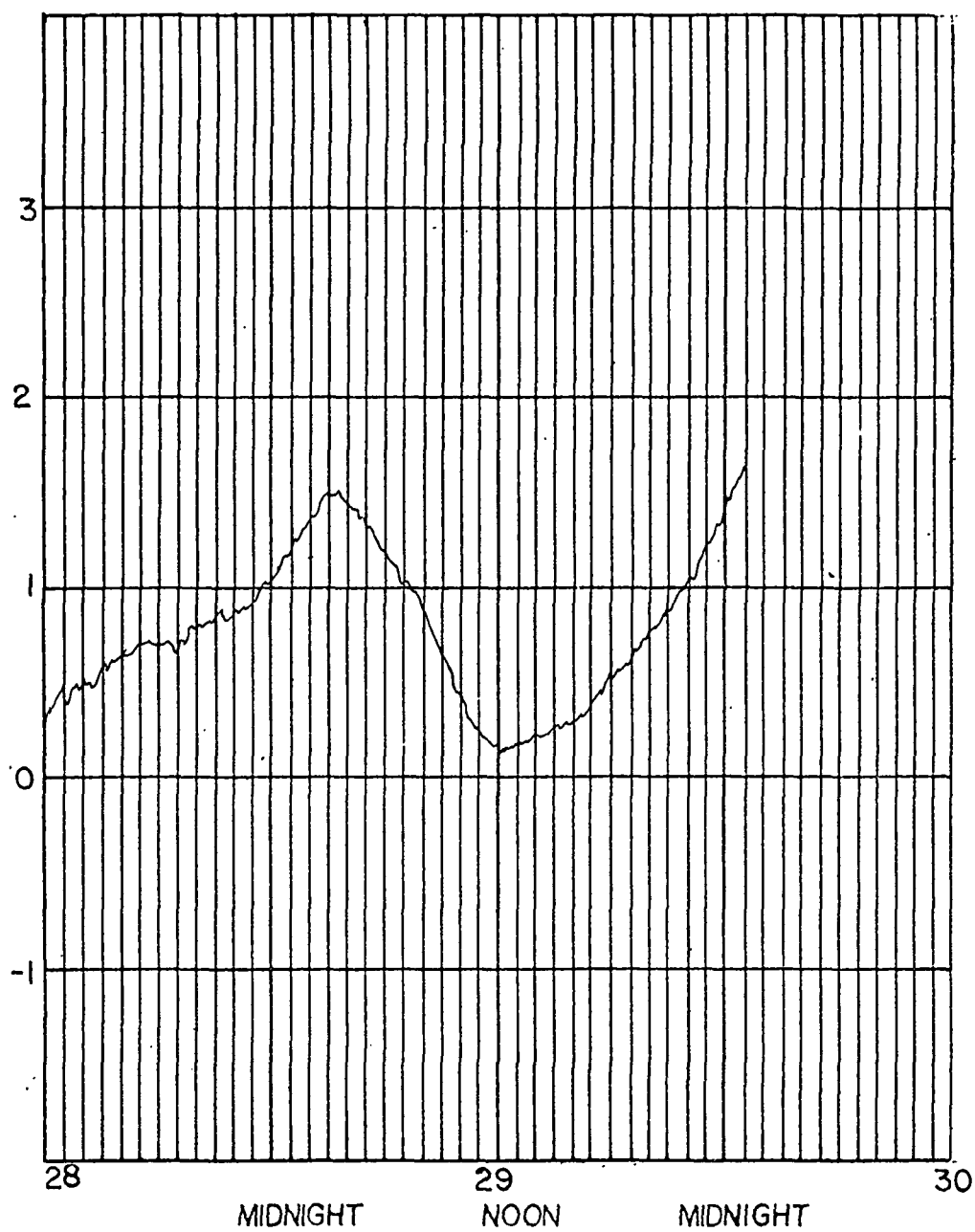


Figure 9. Tides at Gulfport, Miss.

Gage Zero 0.00 MSL

August 29, 1972.

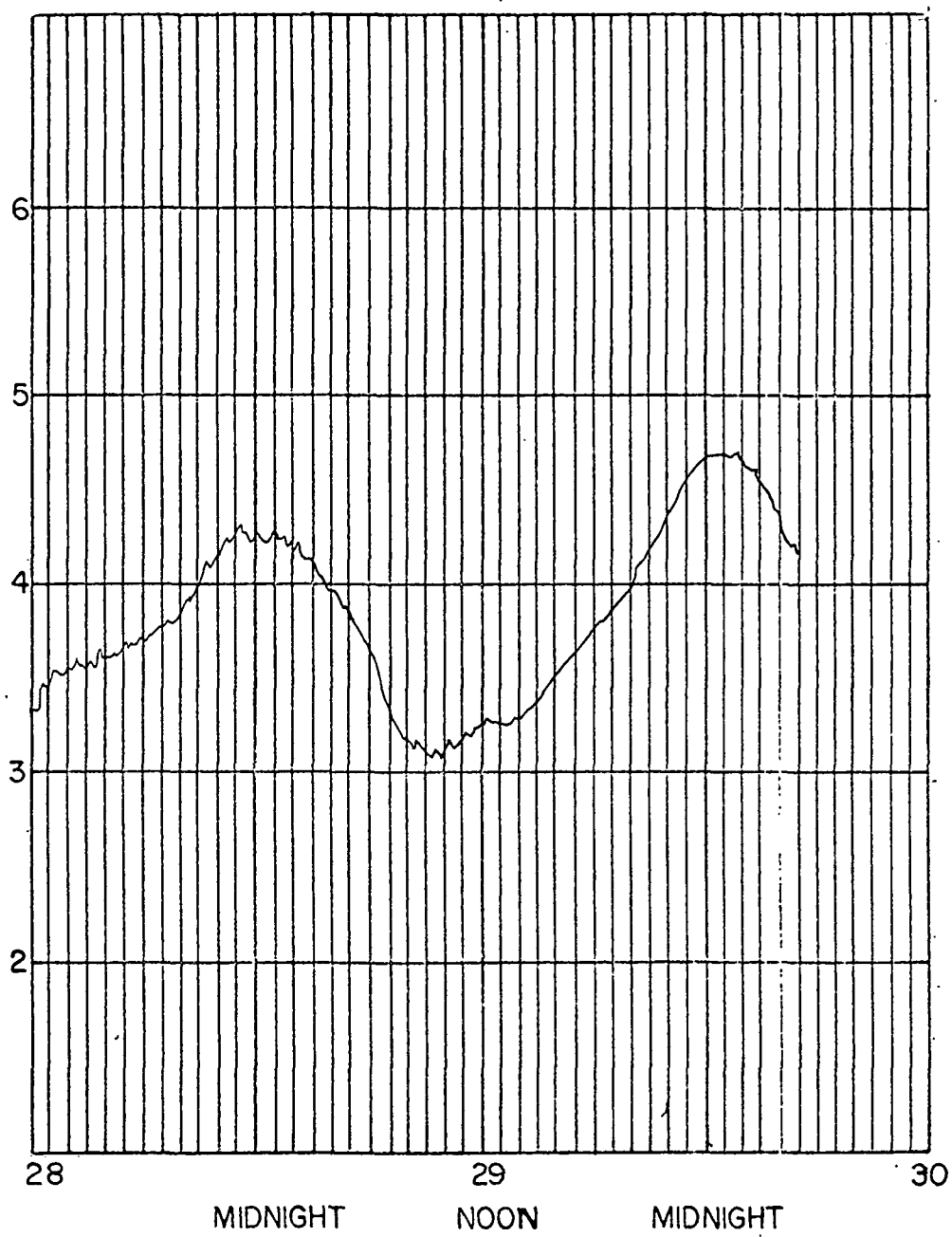


Figure 10. Tides at Pascagoula, Miss.

Gage Zero 3.11 MSL

August 29, 1972.

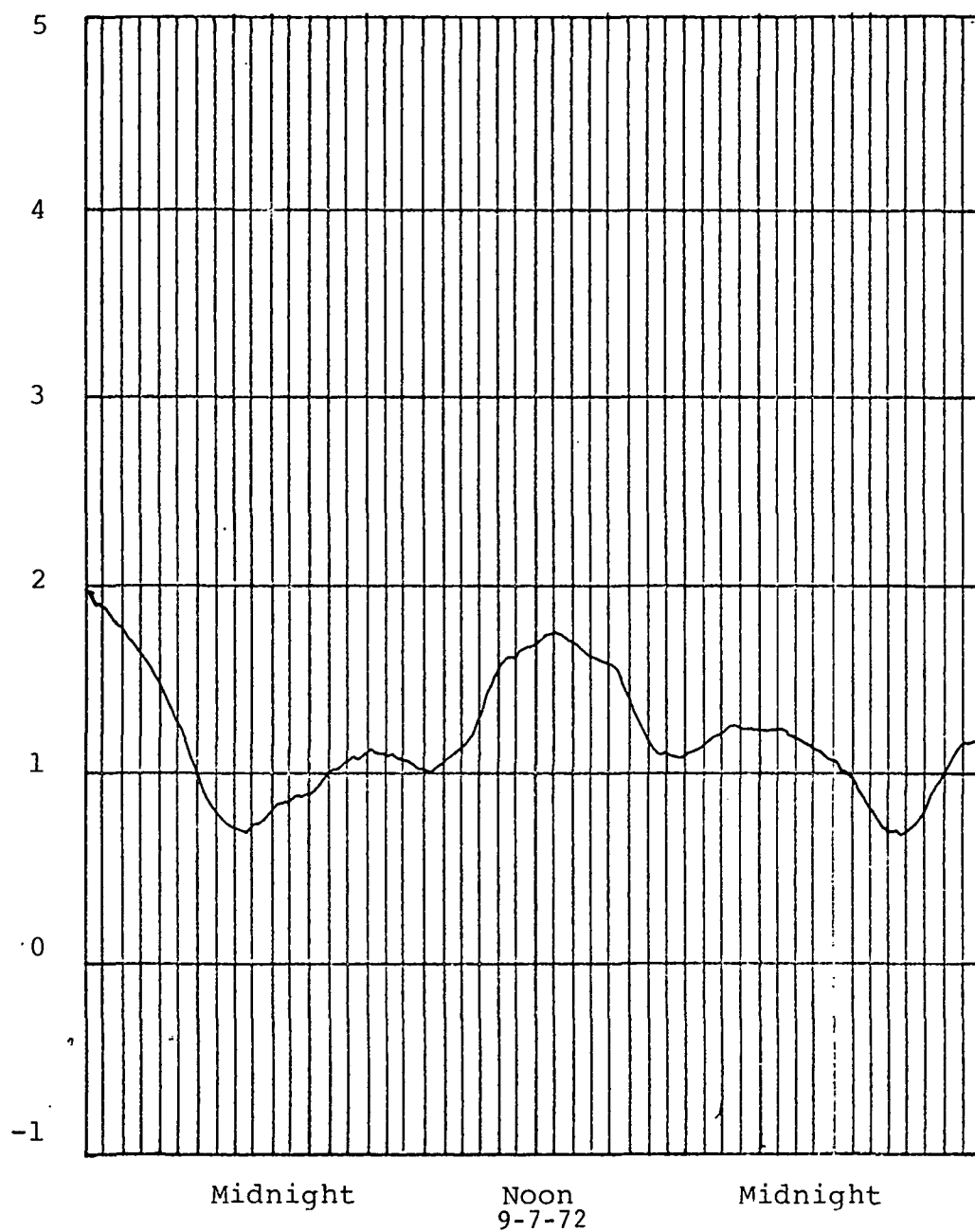


Figure 11. Tides at Gulfport, Miss.

Gage Zero 0.00 MSL

6, 7, 8 September 1972.

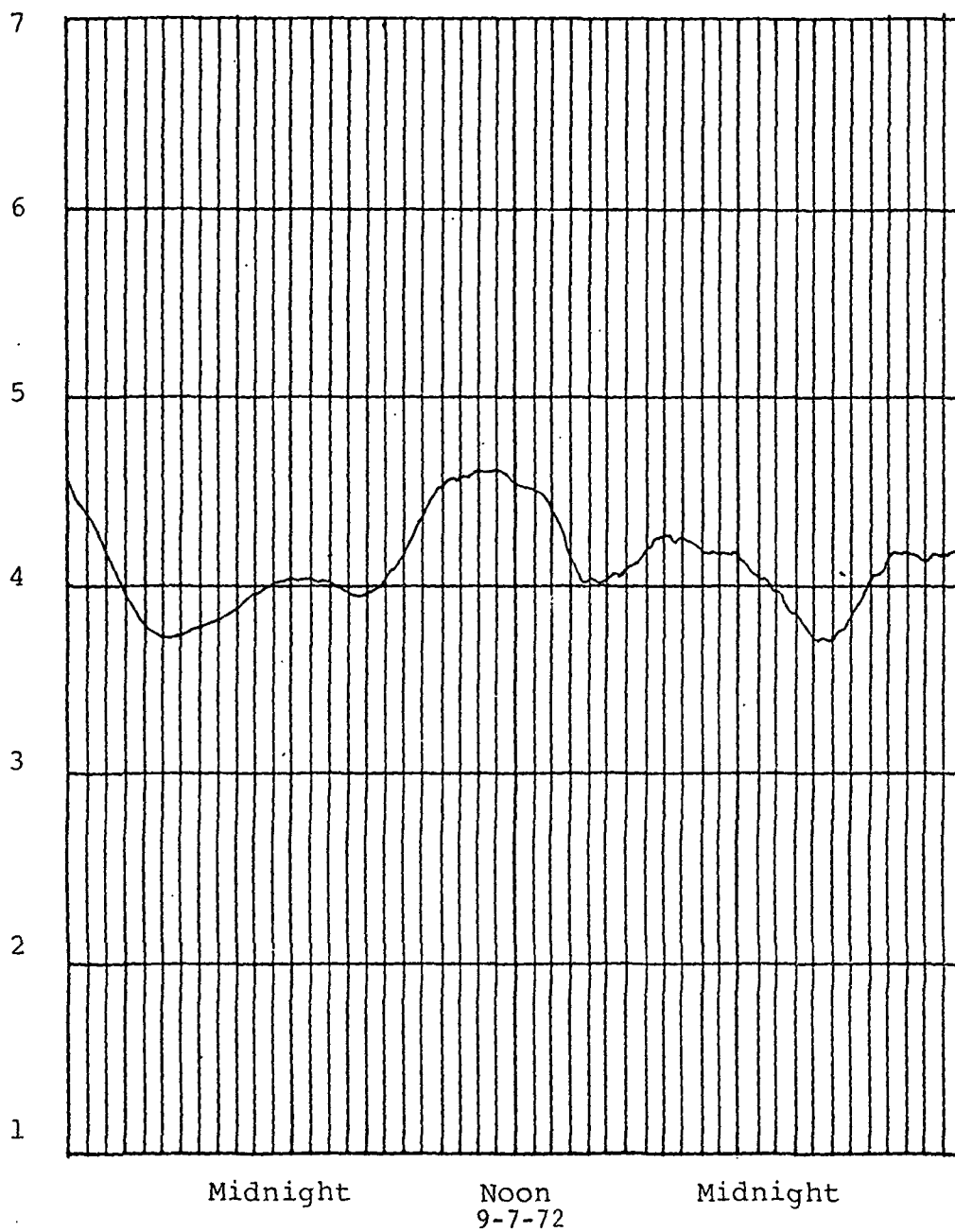


Figure 12. Tides at Pascagoula, Miss.

Gage Zero 3.11 MSL

6, 7, 8 September 1972.

TABLE 4
STATION LOCATIONS
AUGUST 15, 1972

<u>Station</u>	<u>Location</u>	
E14	30°14'28"	88°18'54"
E15	30°17'27"	88°18'54"
E16	30°20'24"	88°18'54"
E17	30°20'24"	88°16'39"
E18	30°17'27"	88°16'39"
E19	30°14'28"	88°16'39"
E22	30°15'54"	88°14'30"
E23	30°18'56"	88°14'30"
E24	30°21'57"	88°14'30"

TABLE 5
STATION LOCATIONS
AUGUST 29, 1972

<u>Station</u>	<u>Location</u>	
D14	30°13'42"	88°32'40"
D15	30°16'43"	88°32'40"
D16	30°19'42"	88°32'40"
D17	30°17'54"	88°30'24"
D18	30°16'12"	88°30'24"
D19	30°13'14"	88°30'24"
D22	30°12'43"	88°27'57"
D23	30°15'43"	88°27'57"
D24	30°18'42"	88°27'57"

TABLE 6
STATION LOCATIONS
SEPT. 7, 1972

<u>Station</u>	<u>Location</u>	
E14	$30^{\circ}14'28''$	$88^{\circ}18'54''$
E15	$30^{\circ}17'27''$	$88^{\circ}18'54''$
E16	$30^{\circ}20'24''$	$88^{\circ}18'54''$
E17	$30^{\circ}20'24''$	$88^{\circ}16'39''$
E18	$30^{\circ}17'27''$	$88^{\circ}16'39''$
E19	$30^{\circ}14'28''$	$88^{\circ}16'39''$
E22	$30^{\circ}15'54''$	$88^{\circ}14'30''$
E23	$30^{\circ}18'56''$	$88^{\circ}14'30''$

TABLE 7
AUGUST 15, 1972

STAT NUMB	TIME CUT	WATER TEMP DEG C	CHLO PH A MG/M3	SALNTY PTS/K	MISSISSIPPI SOUND FIELD AND LABORATORY MEASUREMENTS							WATER DEPTH FT	DUTL NO.	FO CUL	REMARKS RS5-3
					AIR TEMP DEG C	RELAT HUMIDY PERCT	WIND DIR DEG	WIND SPD KN	SECH VISB FT	SEA STAT FT					
															Temp. Salinity
E14	1023	28.7	2.7	27.47	27.8	83.5	68	5	7.0	.5	17.0	3	..		29.0 27.9
E15	1005	28.9	2.2	29.26	28.2	79.8	68	3	6.0	*****	15.0	2	..		29.1 29.7
E16	940	29.0	4.9	28.51	27.7	87.4	68	3	4.5	*****	11.0	1	..		29.1 28.9
E17	1112	28.7	4.5	27.96	27.4	83.5	23	3	2.0	*****	6.0	6	..		29.0 28.6
E17	1245	28.6	6.0	27.93	26.6	91.3	135	3	2.5	*****	6.0	12	..		28.8 29.6
E18	1054	28.7	6.3	25.47	27.1	87.4	23	5	3.0	.5	11.0	5	..		28.9 26.1
E18	1224	28.7	8.0	25.46	26.6	91.3	160	5	4.5	.5	11.0	11	..		29.0 26.0
E19	1035	8.6	.2	26.65	27.1	75.8	23	5	7.5	.5	8.0	64	..		26.9 27.2
E19	1208	28.3	2.0	26.39	26.3	95.5	180	2	4.0	*****	7.0	10	..		28.5 27.3
E22	1154	28.5	2.9	24.79	27.0	83.3	180	5	6.5	.5	12.0	9	..		28.7 25.1
E23	1137	28.0	5.0	25.93	27.0	87.4	157	4	1.5	*****	5.0	8	..		26.3 26.4

TABLE 8
AUGUST 29, 1972

STAT NUMB	TIME CUT	WATER TEMP DEG C	CHLU PH A MG/M3	SALNTY PTS/K	MISSISSIPPI SOUND FIELD AND LABORATORY MEASUREMENTS							WATER DEPTH FT	BOTT NO.	FU COL	REMARKS RS5-3
					AIR TEMP DEG C	RELAT HUMIDY PERCT	WIND DIR DEG	WIND SPD KN	SECH VISB FT	SEA STAT FT					
															Temp. Salinity
014	840	28.5	1.3	31.04	25.5	82.9	45	14	9.0	2.0	10.0	33	10		28.7 31.7
015	915	28.5	2.6	30.62	26.7	79.1	45	14	7.0	2.0	12.0	34	12		28.7 31.2
016	940	28.5	16.2	29.52	28.5	62.1	45	12	4.0	1.0	4.0	35	14		28.9 30.2
017	1010	28.2	15.4	29.84	29.0	58.8	45	12	2.5	1.0	16.0	36	16		28.4 30.4
017	1215	29.5	9.999	29.89	33.3	60.5	70	10	3.5	.5	15.0	42	14		29.8 30.6
018	1025	28.8	4.0	29.96	28.9	62.1	45	12	7.0	1.0	17.0	37	10		29.1 30.6
018	1235	29.3	2.7	29.48	32.5	60.1	70	10	7.0	1.0	18.0	43	8		29.8 30.6
019	1045	28.8	2.1	29.59	29.0	62.1	70	10	9.5	1.5	20.0	38	8		29.2 30.3
019	1300	29.0	2.7	29.38	32.0	59.7	70	8	6.5	.5	17.0	44	8		29.2 30.1
022	1105	28.7	3.7	28.08	29.5	65.6	70	10	7.0	1.0	11.0	39	8		29.0 29.8
023	1130	28.8	4.4	29.97	30.8	60.1	70	10	8.0	1.0	15.0	40	10		29.5 30.7
024	1155	29.0	4.2	29.45	32.5	54.7	70	10	4.0	1.0	8.0	41	12		29.2 30.0

TABLE 9
SEPTEMBER 7, 1972

STAT NUMB	TIME LUT	WATER TEMP DEG C	CHLO PH A MG/M3	SALNTY PTS/K	MISSISSIPPI SOUND FIELD AND LABORATORY MEASUREMENTS							WATER DEPTH FT	DUTL NO.	FU CUL	REMARKS RS5-3 Temp. Salinity
					AIR TEMP DG C	RELAT HUMIDY PERCT	WIND DIR DEG	WIND SPD KN	SECH VISB FT	SEA STAT FT					
E14	925	29.2	2.2	31.22	29.7	80.5	90	5	6.5	1.5	14.0	1	..	29.4 31.7	
E14	1245	29.5	1.9	31.39	32.0	80.5	100	10	8.5	.5	15.0	12	..	29.8 31.7	
E15	945	28.8	2.8	29.80	29.7	87.8	90	10	5.5	1.5	16.0	2	..	29.1 30.1	
E16	1010	29.3	3.5	27.46	31.5	87.8	90	10	6.5	1.0	10.0	3	..	29.6 27.8	
E17	1025	29.1	3.3	24.76	29.9	80.5	90	10	5.5	.5	8.0	4	..	29.5 25.2	
E17	1155	29.5	4.6	24.40	31.5	80.5	100	10	4.5	.5	4.5	7	..	29.8 24.8	
E18	1040	29.0	2.4	25.68	29.9	80.5	93	10	6.5	1.0	11.0	5	..	29.4 26.1	
E18	1215	29.3	3.0	26.37	31.5	77.0	100	10	6.0	.5	12.0	10	..	29.5 26.7	
E19	1100	28.7	2.8	29.88	30.2	80.5	100	10	6.0	1.0	11.0	6	..	29.1 30.4	
E19	1230	29.9	2.7	30.18	31.4	80.5	100	10	5.5	.5	10.0	11	..	29.2 30.5	
E22	1110	29.1	4.0	27.73	31.3	80.5	85	10	5.5	1.0	9.0	7	..	29.5 28.1	
E23	1130	29.5	8.7	22.27	32.0	80.5	135	10	2.5	.5	7.0	8	..	29.8 22.7	

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1. Sea Remote Sensing Program, Mississippi Sound Remote Sensing Study, July 22, 1971, Surface Measurements.
2. Mississippi Sound Study, Part I Surface Measurements from Experiment II, November 10, 1971, Surface Measurements.
3. Sea Remote Sensing Program, Mississippi Sound Remote Sensing Study, January 26, 1972, Report #010, Surface Measurements.
4. Sea Remote Sensing Program, Mississippi Sound Remote Sensing Study May 2 & 4, 1972, Report #015, Surface Measurements.
5. Sea Remote Sensing Program, Mississippi Sound Remote Sensing Study July 6, 1972, Report #021, Surface Measurements.
6. Sea Remote Sensing Program, Mississippi Sound Remote Sensing Study July 6, 1972, Report #022, Remote Measurements Light Aircraft.
7. Sea Remote Sensing Program, Mississippi Sound Remote Sensing Study July 11, 19, 25, and August 1, 1972, Report #023, Surface Measurements.
8. Atwell, B. H. and G. C. Thomann. Mississippi Sound Remote Sensing Study, NASA 4th. Annual Earth Resources Program Review, January 1972.
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ERL/NMF ERTS-A WEEKLY MISSIONS
AUGUST 15, AUGUST 29, & SEPTEMBER 7

